

AAFEX-II Status Report #6 – 26 March 2011 (Iva Anderson's 88th birthday!)

Primary Activities: Complete and dress sampling system installation; undergo safety inspection; perform line loss study; conduct equipment shakedown test

Weather: 40 F, mostly clear with strong southerly winds at 0700; winds strong throughout the day, varying from 180 to 270 in direction. Bright sunshine with temperatures in the mid-50s by mid-afternoon.

Pre-test Activities: Tension levels were somewhat high, as much work remained to be completed before the scheduled 2 pm shakedown engine run.

- Eddie, Luke and Jonathan conducted line-loss studies on the 30 m sampling lines and found transport efficiencies through the 35- to 45-m-long tubes to vary from 60 to 80% for <20 nm particles to ~90% for particles >100 nm in diameter (Figure 1).
- Aerodyne (Figure 2), MST and LaRC performed last-minute preparations on downstream sampling equipment. The Aerodyne Mobile Laboratory (Figure 3)--whose instrument suite includes an single-particle AMS, EEPS, SMPS, CPC, two QCL spectrometers, NO_x and O₃ sensors, and a PTRMS—was parked on the east ramp and equipped with a short-wave radio so that its occupants could stay in contact with the main encampment.
- Team E-31 spent the morning testing system flow and evaluating instrument performance (Figure 4).
- AEDC led the charge in battening down the hatches on the 1 m rake stands. Critical tasks included tying valve boxes to the traversing stands (Figure 5) and dressing cables, hoses and wires (Figure 6). DC-8 QA lead, Scott Silver, inspected the installation after lunch and, with the exception of a few dangling wires and tubes which were quickly secured with cable ties, pronounced it ready for engine shakedown.

First Engine Run—Equipment Shakedown: Project-scientist Bruce polled each participating group during the morning and found that, with the exception of having a few malfunctioning instruments, all teams were ready for a 1400LT engine run. A pre-mission meeting was held in the west-area building at 1330 wherein participants were reminded of engine-run rules and safety considerations and briefed on the planned test matrix. The primary test objectives were to: 1) evaluate sampling system integrity, communications and test procedures; 2) exercise sample dilution and valving systems, and 3) evaluate instrument performance. The test would include an initial power ramp with two minute dwell times at 4, 7, 30, 65, 85 and 100% power to address objective 1 then 12 min runs at these same power settings to address objectives 2 and 3. Participants departed for their stations around 1345.

Although winds were nearing DC-8 limits, engines were started around 1420 and a stepped power ramp was initiated shortly thereafter. At 85% power, strong southerly winds produced a compressor stall in engine #3 and the engines were immediately powered back to idle. The

aircraft crew closely watched readouts and determined that engine operating parameters were within acceptable limits (i.e., the engine was not damaged), but decided to cap power at 30% to prevent an additional stall. The AAFEX team conducted sampled emissions at 4, 7 and 30% thrust and asked for engine shut off around 1510. Despite the relatively short runtime, a great deal was learned:

- Crew members noted that the compressor stall occurred while winds were within published limits, which may necessitate a reduction in acceptable cross-wind speeds for runs at high engine powers.
- Cross winds also prevent low-power exhaust plumes from intercepting the 30-m and 143-m sampling inlets. This will be a problem for the planned exhaust plume chemistry and fuel sulfur experiments.
- With the exception of a couple flapping cables and insulation blankets and as a result of lessons learned in previous missions, all equipment stayed firmly attached to the apron at high thrust conditions.
- Communications were not optimum: some groups did not have clearly identifiable call names and others were on separate com circuits so that messages had to be relayed through an operator with dual access.
- The common aerosol sampling/dilution system did not operate properly when connected to the 1-m valve boxes.
- High occupancy (10) in the E-31 trailer made communications difficult and reduced access to equipment.

These issues were addressed in a post-mission meeting and should be resolved before engine runs resume at 0600 on Monday morning.

Agenda for Sunday

- No engine runs, DC-8 crew off for the day.
- AEDC to complete installing pressure transducers, thermocouples and E-31 sensors
- Experiment groups to repair/characterize instruments and reduce data.

Plans for Monday

- Exhaust plume mapping
- JP-8 emission characterization

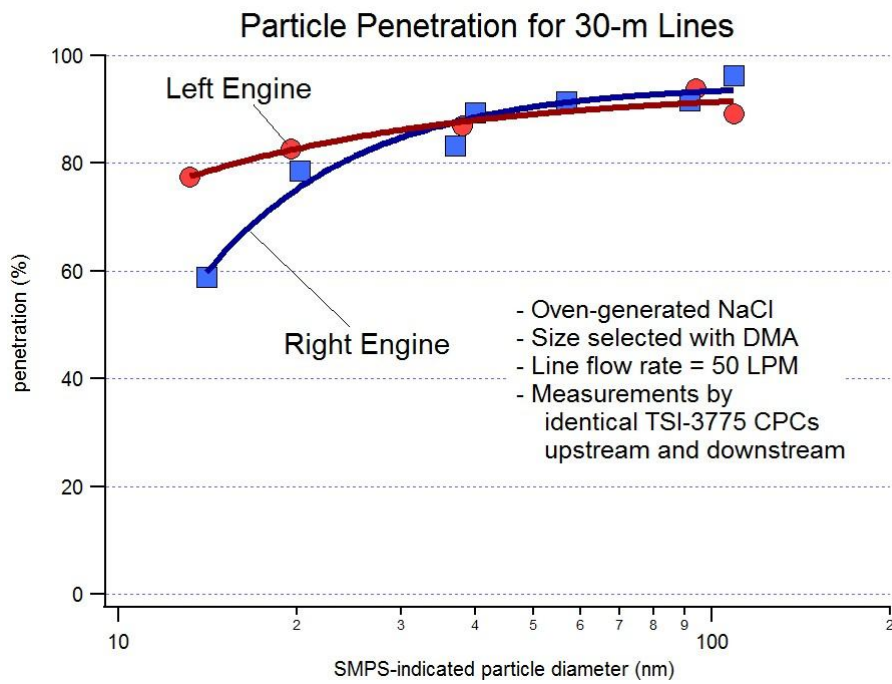


Figure 1. Transmission efficiency test results for the left and right 30-m inlet probes. Test will be repeated periodically to determine how efficiencies change as the lines become dirty with use.



Figure 2. Eben works on the heated inlet atop the ARI/LaRC downstream trailer.



Figure 3. ARI Mobile Laboratory arrayed with a variety of antennas, inlets and sensors and awaits plume encounters during the Saturday afternoon engine run.



Figure 4. Greg gets his laptop warmed up in preparation for taking high-frequency soot data during the afternoon test.



Figure 5. The E-31 and AAFEX-II valve boxes being tied together with angled aluminum and lashed to the 1-m traversing table behind the #2 engine.



Figure 6. Orderly appearance of the #3 engine exhaust sampling equipment after the application of several dozen zip ties.